A. No affirmative evidence mentioned. Gray, Lesley, Dana, Gould.

B. Evidence derived from revelation. Young, Cook, Hill, Barnard.

4. Evidence from science affirmative (5).

A. No evidence cited. A. Hall.

B. Evidence psychophysical. Pierce, Cope.

C. Evidence spiritualistic. Wallace, Coues.

MICROSCOPY.[1]

EYES OF MOLLUSCS AND ARTHROPODS.[2]

Preparation of Young Pectens from 1–3 mm. long. I. MOLLUSCS.—1. Specimens are placed in a mixture of equal parts of sublimate and picro-sulphuric acid. After ten or fifteen minutes they are washed in thirty-five per cent. and seventy per cent. of alcohol.

2. The shells are then opened and the mantle dissected out with needles. Thus treated, the shape of the mantle is well preserved, whereas if removed before hardening it becomes much coiled and twisted.

3. Each mantle edge may be cut, according to its size and curvature, into three or four pieces, and these will then lie sufficiently straight for convenient sectioning.

It is necessary to use a different reagent for nearly every part of the eye.

The Rods.—Chromic acid gives the most varied results according to the strength, time of action, and temperature of the solution, or by various combinations of these three. For instance, one-twentieth to one-fifth per cent. for thirty to forty hours failed to give any conception of the structure of the rods, while other parts of the retina, and of the eye itself, were well preserved; but when allowed to act for half an hour at a temperature of from 50° to 55° C., perfectly preserved rods with their nervous net-works are obtained, while, on the other hand, the remaining tissues become so granular and homogeneous as to be unfit for study. This treatment allows the rods to be removed in flakes and their ends examined without the aid of sections. *It is only in this way that the axial nerve-loops can be observed.*

The Lens.—The lens is best prepared for sections by either sulphuric or picro-sulphuric acid; by the first reagent its shape is best retained, and the lens itself is less liable to be drawn away from the surrounding tissue; the latter reagent, however, brings out more sharply the configuration of the cells and allows a better stain of the nuclei to take place.

The Retinophoræ.—The retinophoræ are well preserved by nearly all the reagents; but in sublimate, in picric acid, or in

[1] Edited by C. O. WHITMAN, Ph.D., Milwaukee, Wisconsin.

[2] Dr. Wm. Patten, Mitth. a. d. Zoöl. Station z. Neapel, vi. p. 733, 1886.

their combinations, they become slightly granular, and remain so closely packed that it is difficult to distinguish the cell boundaries. Chromic acid, one-fifth per cent. for three or four days, contracts the cells and gives preparations in which the boundaries and general arrangement of the retinophoræ are easily studied.

Sections of the Eye.—In order to obtain the best sections of the adult eye with *all* the parts in the most natural position, it is necessary to treat them first with one-tenth per cent. of chromic acid for half an hour, then in one-twentieth per cent. for twenty-four hours; one-tenth per cent. for twenty-four hours, and finally one-fifth per cent. for forty-eight hours or more. Next to this method, it appears that solutions of sulphuric acid (twenty drops to fifty grammes of water) give the best preparations (for sectioning), of everything except the rods.

The double layer of the sclerotica and the fibres penetrating it can be seen in sections of eyes treated twenty-four hours in one-fifth per cent. chromic acid.

Maceration and Dissection.—The *pigmented epithelial cells* of Pectens' eyes and the cells of the *cornea* are easily isolated by treatment with Müller's fluid or bichromate of potash one-half per cent. for two or three days. For the maceration of all other elements weak chromic or sulphuric acid is used. For the outer ganglionic cells, which are very difficult to isolate, maceration in one-fiftieth per cent. chromic acid gives excellent results, after previously fixing the tissue in one-fifth per cent. for a few minutes.

For the *retinophoræ*, one-twentieth per cent. for four or five days proves very useful.

Sulphuric acid, five drops to thirty grammes of sea-water, gives the best results for the nerve-endings in the retinophoræ (not in the rods) and for the nervous inner prolongation of the outer ganglionic cells.

In order to isolate pieces of the cornea with the subjacent *pseudo-cornea* and the circular fibres on the outer surface of the lens, it is better to macerate the eyes in sulphuric acid as given above. The same treatment retains to perfection the natural shape of the lens, which may then be isolated and its surface studied to advantage.

It is necessary for the study of the *circular retinal membrane*, the *septum*, and the *retina* itself, to isolate the latter intact. Maceration in chromic acid either makes the retina too brittle or too soft, while the axial nerve-fibres remain so firmly attached to the retina that it is difficult to isolate it without injury. But this may be easily and successfully done by maceration for one or two days in the sulphuric acid solution. By this treatment the *retina*, together with the *septum* and *circular retinal membrane*, may be detached entire.

Surface views of the retina show the peripheral outer gangli-

onic cells. The *argentea* may be very easily separated in large sheets by macerating for four or five days in bichromate of potash of one per cent.

Sulphuric acid is a most valuable macerating as well as *preservative reagent.* In weak solutions (forty drops to fifty grammes) entire molluscs, without the shell, have been kept in a perfect state of preservation for more than six months. For cilia and nerve-endings it is exceptionally good.

The eyes of Arca and Pectunculus may be macerated either in Müller's fluid or chromic acid. Undiluted Müller's fluid in twenty-four hours gives more satisfactory preparations than a weak solution which is allowed to act for a longer period. Chromic acid, one-fifth per cent. for ten or twelve days, gave most of the preparations from which the drawings of the nerve-endings were made. A few drops of acetic and osmic acid added to distilled water give a very energetic macerating fluid for the epithelium of marine molluscs. Such preparations led to the discovery of the very delicate outward continuations of the pigmented cover-cells in the compound eyes of Arca.

II. ARTHROPODS.—In order to demonstrate the presence of the *corneal hypodermis* in the faceted Arthropod eye, and the connection of the so-called "rhabdom" with the crystalline cone cells, it is necessary to resort to maceration. In most cases it is hardly possible to determine these important points by means of sections alone.

The ommateum of fresh eyes, treated for twenty-four hours or more with weak sulphuric or chromic acid, or in Müller's fluid, may be easily removed, leaving the corneal facets with the underlying hypodermis uninjured. Surface views of the cornea prepared in this way show the number and arrangement of the corneal cells on each facet. In macerating the cells of the ommateum it is not possible to give any definite directions, for the results vary greatly with different eyes, and it is also necessary to modify the treatment according to the special point to be determined. It is as essential to isolate the individual cells as it is to study cross and longitudinal sections of the pigmented eyes. In determining the number and arrangement of the cells and the distribution of the pigment the latter method is indispensable; it should not be replaced by the study of depigmented sections, which should be resorted to in special cases only.

In *fixing* the tissues of the eye, it is not sufficient to place the detached head in the hardening fluid; the antennæ and mouth parts should be cut off as close to the eye as possible in order to allow free and *immediate* access of the fluids to the eye. When it is possible to do so with safety, the head should be cut open and all unnecessary tissue and hard parts removed. With abundant material, one often finds individuals in which it is possible to separate, uninjured, the *hardened* tissues of the eye

from the cuticula. This is of course a great advantage in cutting sections. The presence of a hard cuticula is often a serious difficulty in sectioning the eyes of Arthropods. This difficulty can be diminished somewhat by the use of the hardest paraffine, and by placing the broad surface of the cuticula at right angles to the edge of the knife when sectioning. Ribbon sections cannot be made with very hard paraffine, but it is often necessary to sacrifice this advantage in order to obtain very good sections.

SCIENTIFIC NEWS.

—Over a year ago the announcement was made that a human skull was found near Worcester, Mass., in such a position with regard to the bones of a mastodon as to indicate that they were contemporaneous. Regarding the authenticity of the mastodon bones there was no doubt, but certain facts seemed to indicate that the human skull was a "plant," but one which was rather skilfully performed. It is now announced that those in Worcester who have been investigating the affair are convinced that the skull was placed where it was found by some one who had a slight knowledge of archæology. As absolute proof is as yet lacking, no names are mentioned, but circumstances point strongly towards a person who is believed to be capable of such a fraud.

—Prof. Herbert W. Conn, of Wesleyan University, will have charge of the biological instruction at the summer school at Martha's Vineyard during the present season.

—*Random Notes on Natural History*, a small monthly magazine started in 1884 by Southwick & Jencks, of Providence, R. I., has been discontinued. The three volumes published contain many notes on the natural history of Rhode Island.

—The announcement has already been made in these pages that early in the present year Ginn & Co., of Boston, were to start a *Journal of Morphology*, under the editorial charge of Dr. C. O. Whitman. We recur to the subject to say that the first number will be issued some time during the present month, and to call the attention of all persons interested in the anatomy, histology, or development of animals and plants to the claims of this journal. It will be the endeavor to make it the equal and the representative in America of such periodicals in Europe as the *Zeitschrift für wissenschaftliche Zoologie* and the English *Quarterly Journal of Microscopical Science*. The name of the editor is a guarantee that the contents will be of the highest character. The plates will be fully equal to those of the best of the foreign journals. Such a journal has long been a desideratum, and it is the duty of every American student to support it.